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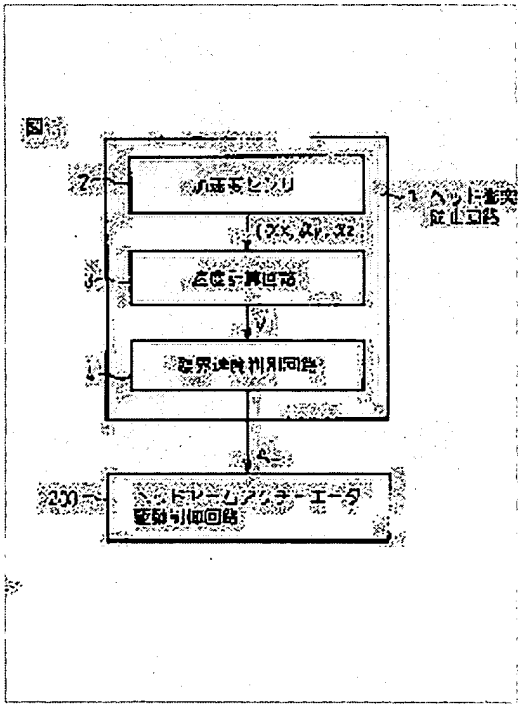
(54) HARD DISK DRIVE

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent crushing due to a fall by predicting a fall shock.

SOLUTION: The hard disk drive has an acceleration sensor inside and is provided with a mechanism which retracts a head on detecting a falling state. In detail, the hard disk drive is equipped with the acceleration sensor and a controller which performs control for retracting the head to a shipping zone when a speed exceeds a certain value, thereby retracting the head of the hard disk drive to the shipping zone before the hard disk drive has a shock due to a fall.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a hard disk drive unit, especially the hard disk drive unit which prevents the collision of the head by the fall impact, and a platter.
[0002]
[Description of the Prior Art] The hard disk drive unit was an element important as storage of a personal computer, as a result of having furthered development about the densification of a magnetic consistency, a miniaturization and thin shape-ization progressed and the recently portable removable hard disk equipment disk appeared (patent reference 1).
[0003] A general view of such removable hard disk equipment 5 is shown in drawing 7 . Drawing 7 is drawing indicated by the following patent reference 1, and is drawing in which taking out a disk cartridge 12 from a removable hard disk 13, and showing a condition especially. A disk cartridge 12 comes to have a chassis 14, the top covering 15, and coil covering 16 grade. Moreover, a removable hard disk 13 comes to have the circuit board 16, the connector 17 with a cartridge 12, and the magnetic-circuit 18 grade for a head arm actuator drive.
[0004] Drawing 8 shows the condition of having removed the top covering 15 of said disk cartridge 12. The disk 19 of a center section is called a platter, and consists of a metal disk, and the magnetic substance is applied. Information is read by memorizing by making it change or detecting a magnetization condition from a head 21 by the head 21 which exists the magnetization condition of the magnetic substance on said platter at the tip of the head arm actuator 20. Migration control of the head arm actuator 20 is carried out by the moving coil 22 for a voice coil motor drive, and said magnetic circuit 18. In addition, in drawing, the head arm actuator 20 shown with a broken line is evacuated to the cypripedium yard which is a non-active region.
[0005] Drawing 9 is the block diagram of the electrical circuit configuration of said removable hard disk equipment. As shown in drawing 9 , an interface circuitry 201, the head arm actuator drive control circuit 203, the positioning control circuit 205, the disk roll control circuit 207, and the data-processing circuit 209 are included in the circuit board 16 carried in the removable hard disk 13. The head arm actuator drive control circuit 203 supplies a driving signal to the moving coil 22 of a voice coil motor based on the position control signal from a positioning control circuit 205, and drives the head arm actuator 20.
[0006] Compared with other removable media, capacity of a removable hard disk is large, a data transfer rate is also high, and since backup can be done comfortably and can also make temporary storage comfortable, it is various fields and the usefulness and convenience are accepted.
[0007] Since it is miniaturized, for example, such a hard disk drive unit is carried as a music player, unlike a fixed type hard disk drive unit, the case dropped from a hand is expected. When this hard disk drive unit is dropped, since the head is evacuated to the cypripedium yard, a head does not collide with a platter in the condition of having not written. However, when writing, by the impact to the hard disk drive equipment by fall, a head 21 collides with a platter 19 and causes the magnetic layer on the front

face of a platter, and destruction of a head. Furthermore, not only a collision place but the problem of the so-called head crash of colliding with other fields of the platter 19 in which the fragment further generated at that time is carrying out high-speed rotation, repeating destruction, and it becoming impossible to use all the fields of a disk may be caused.
[0008] It has the sensor which senses vibration of a head inside the head assembly of a hard disk drive unit to this kind of problem, and there are some which suspend actuation of a head assembly by the detection signal of a sensor (for example, the following patent reference 2). Moreover, when the value which detected the impact by 3 shaft acceleration sensor, and was detected by this detector is beyond default value, a high speed is made to rotate the rotational frequency of a spindle motor from stationary rotation, a head is surfaced, and there is a thing which makes it evacuate to a shipping zone (location of B in drawing) (the following patent reference 3).
[0009] The technique of said patent reference 3 was not what a high speed is made to rotate the rotational frequency of a spindle motor from stationary rotation, and a head is surfaced, evacuates to a cypripedium zone, performs processing after an impact so to speak, predicts a collision to fall of equipment, and prevents a head crash beforehand, when the value detected by the detector was beyond default value.
[0010]
[Patent reference 1] JP,2002-367362,A [the patent reference 2] JP,2-44458,A [the patent reference 3] JP,8-315498,A [0011]
[Problem(s) to be Solved by the Invention] Although a removable hard disk drive unit is beginning to be used as storage for pocket music players recently as described above, unlike a personal computer, such a pocket music player processes by always reading data at the time of use, and is performing performance playback. This means that the condition that a head is located on a platter continues for a long time. For this reason, in such pocket player equipment, the cure against fall is a very important technical problem.
[0012]
[Means for Solving the Problem] Especially this invention tends to predict an impact in advance, to such a technical problem, to the head crash by fall, it tends to constitute it so that a head may be evacuated beforehand, and it is going to prevent the crash by fall beforehand.
[0013] For this reason, in a hard disk drive unit, this invention prepares the configuration which publishes a head evacuation order, when a head crash prevention circuit is built in and a fall condition is detected. That is, the 1st invention is hard disk drive equipment characterized by being constituted and becoming so that acceleration is detected, it may have the head crash prevention circuit which generates the signal which evacuates a head when a rate exceeds constant value, and a head may be evacuated to a cypripedium zone with said signal. Moreover, the rate count circuit where said head crash prevention circuit is connected to an acceleration sensor and said acceleration sensor, and the 2nd invention calculates a rate based on the output from this sensor, When it connects with said rate count circuit, the critical velocity beforehand determined as said calculated rate is measured and said calculated rate exceeds said critical velocity, it is the hard disk drive unit according to claim 1 characterized by consisting of a critical-velocity distinction circuit which generates an alarm signal. The 3rd invention is a hard disk drive unit according to claim 2 characterized by said head crash prevention circuit consisting of one chip. The 4th invention is a hard disk drive unit according to claim 2 characterized by at least the part and acceleration sensor of said head crash prevention circuit except said acceleration sensor consisting of one chip. The 5th invention is a hard disk drive unit according to claim 2 characterized by said acceleration sensor being 3 shaft acceleration sensor. The 6th invention is a hard disk drive unit according to claim 5 characterized by said 3 shaft acceleration sensor being a piezoresistance mold 3 shaft acceleration sensor. The 7th invention is a hard disk drive unit according to claim 2 or 3 characterized by laying said head crash prevention circuit in the substrate of a hard disk drive unit. the 8th invention -- said head crash prevention circuit -- a hard disk drive circuit and one ---like -- IC -- it is the hard disk drive unit according to claim 2 characterized by coming-izing.
[0014]
[Embodiment of the Invention] Hereafter, before explaining the mode of operation of this invention

using a drawing, the view of this invention is explained taking the case of a pocket music player. When a pocket music player falls, the acceleration which joins the hard disk drive unit built in this player turns into gravitational acceleration g, but this condition is continued until this player collides with the ground. Therefore, when the condition that the acceleration which joins a hard disk drive unit is gravitational acceleration g continues beyond predetermined time conversely, it can be said that the hard disk drive unit has fallen.

[0015] When exceeding the critical value which the acceleration which joins a hard disk drive unit turns into gravitational acceleration g, and the condition carries out predetermined time continuation, therefore has a rate, it must judge that it has fallen and must control to evacuate a head arm to a cypripedium yard. Then, acceleration is detected and a hard disk drive unit falls according to gravity, and if it detects that the rate exceeded constant value, it judges that this equipment has fallen, and it is made evacuate a signal to that effect to a head arm actuator control circuit, and to evacuate delivery and a head to a cypripedium yard in this invention.

[0016] Drawing 1 is the block diagram showing the configuration of this invention. In drawing 1 , the head crash prevention circuit 1 detects acceleration, and calculates a rate based on this acceleration, when a rate exceeds constant value, the signal which evacuates a head is generated, and in response to said signal, a head arm actuator drive control circuit evacuates a head to a cypripedium zone. Such a head crash prevention circuit 1 comes to have an acceleration sensor 2, the rate count circuit 3 linked to this, and the critical-velocity distinction circuit 4 further connected to this rate count circuit 3.

[0017] The head crash prevention circuit 1 is laid in the circuit board of the suitable removable hard disk 16 near [which consists of one chips in order to reduce a component-side product and weight, for example, does not check actuation of the movable object of the chassis of a disk cartridge, or a head arm actuator] a cypripedium yard which gives a location or the following explanation. Moreover, it can also IC-ize to a hard disk drive circuit and one. Or it can also create as an IC united with the hard disk drive circuit.

[0018] Although the example by which the head crash prevention circuit 1 is formed into 1 chip was explained, it is good also considering the part and said acceleration sensor 2 of the head crash prevention circuit except an acceleration sensor as one chip, and the acceleration sensor 2 which constitutes the head crash prevention circuit 1, the rate count circuit 3, and the critical-velocity distinction circuit 4 may be created as a device according to individual. Moreover, as the approach of the formation of 1 chip, each functional element loading may be carried out on the same die, and 1 chip may be formed with a package. Furthermore, other devices carried in the hard disk drive unit, and/or a hard disk drive unit and the device of the exterior which can be communicated may be burdened with a part of function of a head crash prevention circuit.

[0019] Next, the acceleration sensor 2 which are the main components of the head crash prevention circuit of this invention is explained. Although what detects the acceleration of three shafts to coincidence with one chip appears as the newest acceleration sensor and it is used in various fields, such as a game machine, a cellular phone, a camera, and an automobile, it explains taking the case of this. Drawing 3 shows the perspective view of the piezoresistive element mold 3 shaft acceleration sensor 2. This sensor 2 contains a piezoelectricity component in the package of 5mmx5mmx1.2mm magnitude, uses resistance change of this component, is one chip and detects the acceleration of three shafts of x, and y and z to coincidence. The configuration of this sensor 2 consists of the connection sections 81 and 82 and ... which connect the central rectangle section 6, the flank 7 which consists of four sides which have and surround this and space, and center sections 71 and 72 and said ... and central rectangle section 6 of four sides each. A piezo-electric element 9 is formed in the top face of this connection section 8. In addition, A and A' expresses the cutting plane line which cuts the center section of said sensor 2 in the direction of a x axis.

[0020] Drawing 4 is the sectional view cut along with cutting-plane-line AA' of drawing 3 . a piezoresistive element 9 -- each connection sections 81 and 82 and ... it comes to be formed upwards The central rectangle section 6 is equipped with the spindle 10 projected in the lower part. In such a configuration, if Force F joins the component with acceleration, the stress sigma proportional to

acceleration will generate deformation in a lifting and said sensor 2, and, as for a sensor 2, the resistance R of this piezoresistive element 25 will change with motions of a spindle 10 in proportion to stress sigma. Drawing 5 is the mimetic diagram showing deformation of said sensor in case the force is added in the two-dimensional direction x of the front face of a sensor and the direction of y. Moreover, drawing 6 is the mimetic diagram showing deformation of said sensor 2 in case the force is added in the direction of the z-axis perpendicular to the front face of a sensor 2. By constituting the bridge circuit (not shown) which consists of said 4 sets of piezoresistive elements 9, a non-balancing electrical potential difference is detected and this detects acceleration.

[0021] Although such a 3 shaft acceleration sensor 2 can detect the dynamic acceleration of said x axis, the y-axis, and the z-axis, it is possible using this output to compute the gravitational acceleration which is the inclination and quiescence acceleration at the time of quiescence.

[0022] Although the signal showing each acceleration of 3 shaft acceleration sensors 2-xy and the direction of the z-axis is generated as described above, acceleration alpha is computed based on these signals, and this acceleration alpha is supplied to the rate count circuit 3. Said acceleration alpha is the circuit which computes a rate V from this acceleration alpha when equal to gravitational acceleration g, and the rate count circuit 3 is calculated by the well-known count approach. The critical-velocity distinction circuit 4 measures the rate V and critical velocity Vc which were received from the rate count circuit 3, when it is V>=Vc, shows a fall condition and carries out alarm signal AL generating.

[0023] This means that equipment has fallen. The alarm signal AL is supplied to the head arm actuator drive control circuit 203 as a signal of the purport which evacuates a head to a cypripedium yard.

[0024] The head arm actuator control circuit 203 controls in response to this alarm signal AL to evacuate a head arm to a shipping zone.

[0025] It explains according to the flow chart about the head crash prevention circuit 1 which shows the above actuation to drawing 2 . The flow of fall detection processing is a processing flow started at intervals of predetermined time. Each acceleration signal of introduction, 3 shaft acceleration sensors 2-xy, and the direction of the z-axis is detected (step 1). The acceleration alpha of equipment is computed based on this acceleration signal (step 2). In the rate count circuit 3, said acceleration alpha and gravitational acceleration g are measured (step 3), and a direction is in agreement, and when it is alpha! =g, it shifts to the Maine processing (step 9). (when it is no) A direction is in agreement, when it is alpha=g, the time amount which this condition continues is clocked and a rate V is calculated using this (step 4). The critical velocity Vc which is a rate which can be regarded as this rate V and equipment having fallen is measured (step 5), at the time of V>=Vc, it judges that the hard disk drive unit has fallen, and the alarm signal AL is generated (step 6). If this alarm signal AL is received, the head arm actuator drive control circuit 203 will control to evacuate a head arm to a shipping zone (step 7). Then, all processings are ended (step 8). In V<Vc, in step 5, it returns to step 1. It can realize using a microprocessor and this processing can also be realized using an individual functional circuit. Moreover, this flow is an example and this invention is not limited to this.

[0026] Moreover, it is good to design in the state of fall of the short time at the time of getting down from a stairway etc., so that a head may not be evacuated. In addition, after going through fixed time amount instead of step 8, it can return to the Maine processing. Moreover, not only music playback but when writing in a music player, it is clear that the idea of this invention is applicable. Here, although the example of a portable hard disk drive unit was taken and being explained, 3 shaft acceleration sensor is applied to a cover-half hard disk drive unit, and the problem of the head crash by fall can be prevented.

[0027] Attention of a user or other men can also be drawn by predicting fall as the further application using the technique which gave [above-mentioned] explanation, and generating an alarm sound according to a prediction result.

[0028]

[Effect of the Invention] Since according to this invention it becomes possible to evacuate a head before a collision even if it drops a hard disk drive unit during R/W of data, the head crash of a hard disk can be prevented beforehand. Therefore, there is no need of evacuating carrying out high-speed rotation of the spindle motor like the conventional technique, and surfacing a head, and it is easy to control.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the head crash prevention circuit of this invention.
[Drawing 2] It is the flow chart which shows the embodiment of this invention.
[Drawing 3] It is the perspective view showing the basic configuration of the piezoresistance mold 3 shaft acceleration sensor 2.
[Drawing 4] In drawing 3 , it is the sectional view of the sensor 2 cut off along with cutting-plane-line AA'.
[Drawing 5] It is a sectional view showing deformation of the sensor 2 when acceleration is added in a x axis or the direction of the y-axis in drawing 4 .
[Drawing 6] It is a sectional view showing deformation of the sensor 2 when acceleration is added in the direction of the z-axis in drawing 4 .
[Drawing 7] It is the general-view Fig. of removable hard disk 11 conventional equipment.
[Drawing 8] It is the front view which removed top covering of the disk cartridge of the equipment of drawing 7 and in which showing the interior of this cartridge 12.
[Drawing 9] It is the block diagram of the electrical circuit configuration of the equipment of drawing 7 .

[Description of Notations]
1 -- Head crash prevention circuit
2 -- Acceleration sensor
3 -- Rate count circuit
4 -- Critical-velocity distinction circuit
9 -- Piezoresistive element
10 -- Spindle
11 -- Removable hard disk equipment
12 -- Disk cartridge
13 -- Removable hard disk
16 -- Circuit board
21 -- Head
22 -- Moving coil for a voice coil motor drive

[Translation done.]